

Recent NIST Activities to Strengthen Forensic Science

John M. Butler, PhD

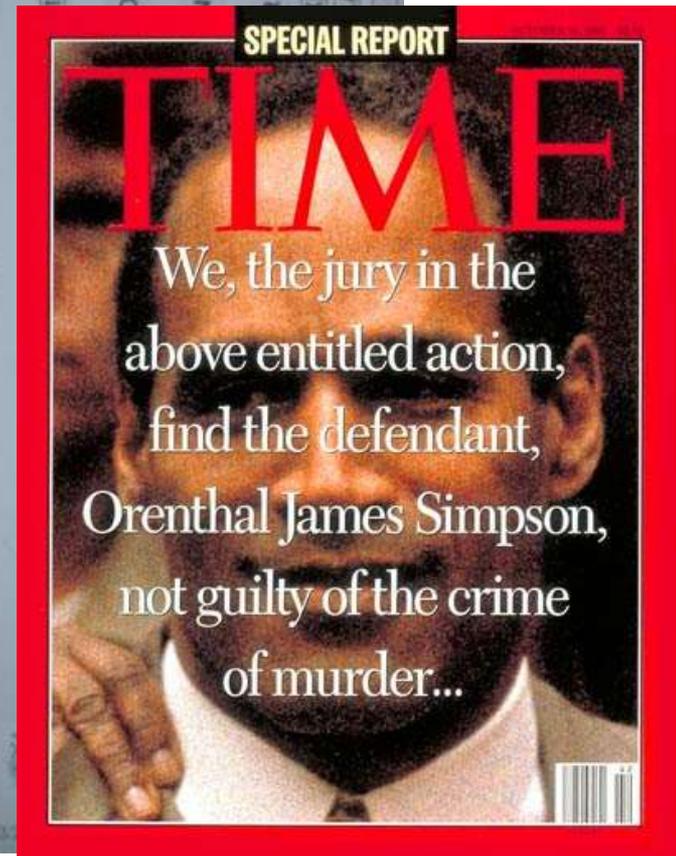
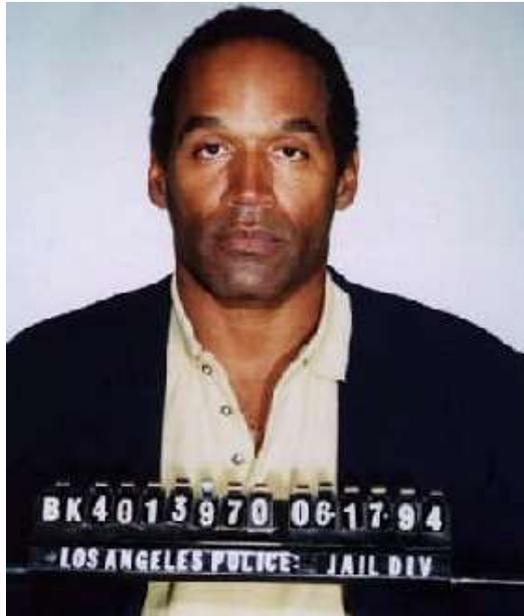
National Institute of Standards and Technology

Cedar Crest College

5th Annual Forensic Science Leadership Lecture

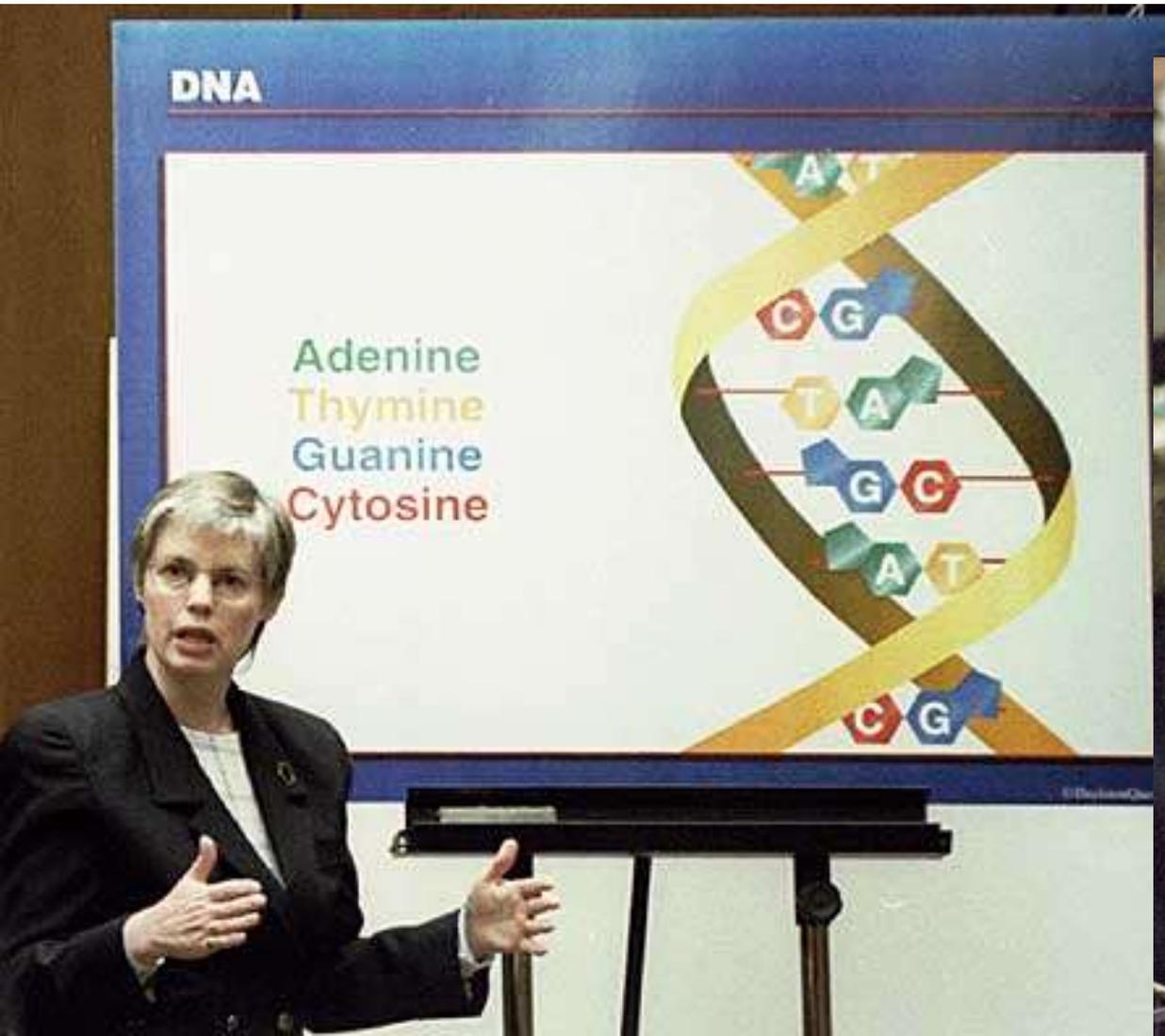
October 8, 2015

O.J. Simpson: Helped Bring DNA Testing to Knowledge of the General Public



The World's Largest Classroom

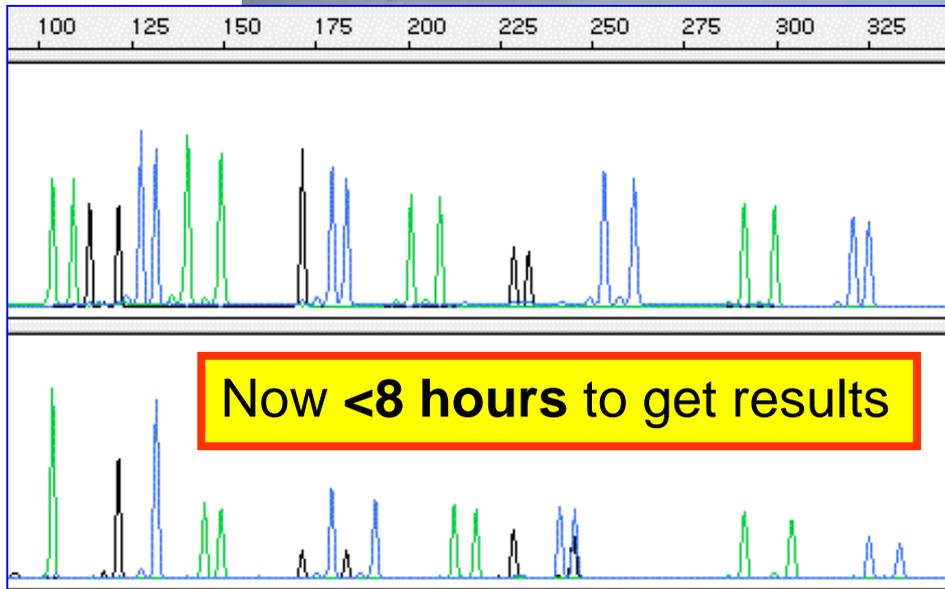
Dr. Robin Cotton in May 1995 teaches >1 billion people watching the O.J. Simpson Trial about DNA



Progress Since 1995...

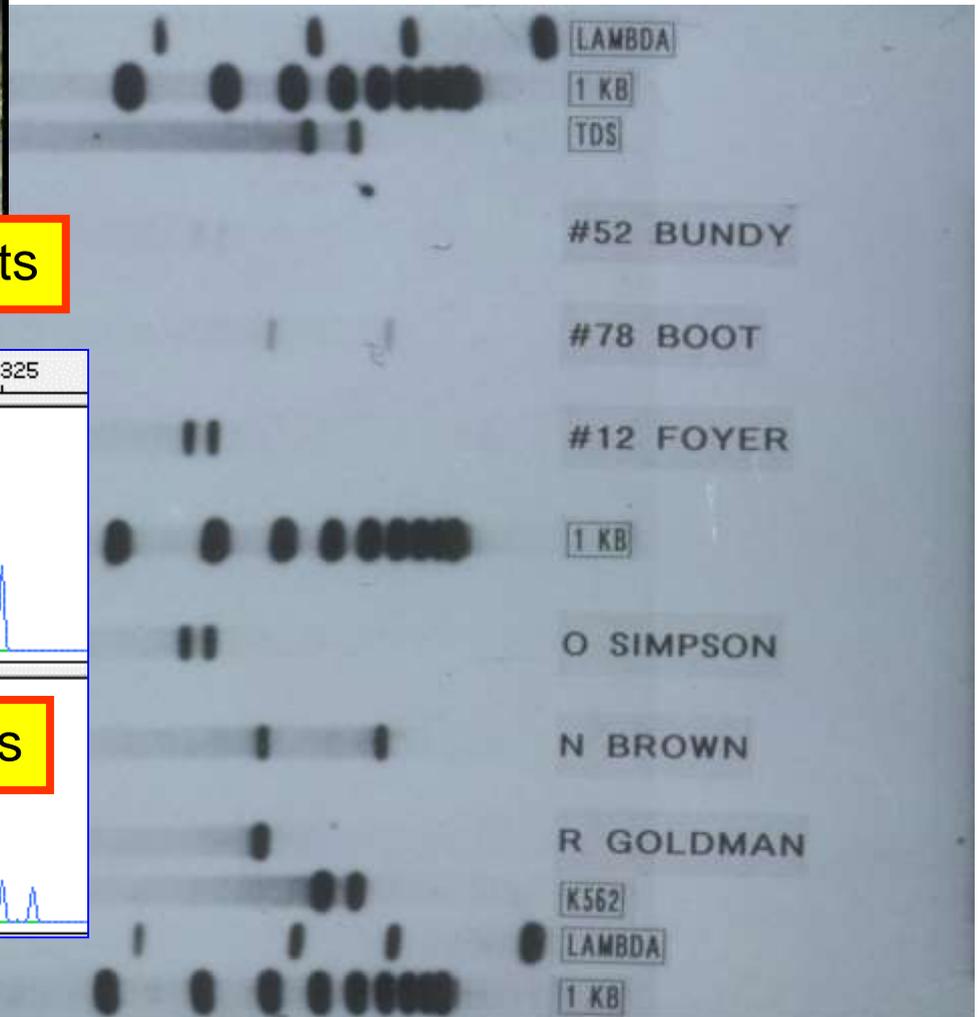


Almost **8 weeks** needed to get results



Now **<8 hours** to get results

O.J. Simpson DNA testing was performed with RFLP

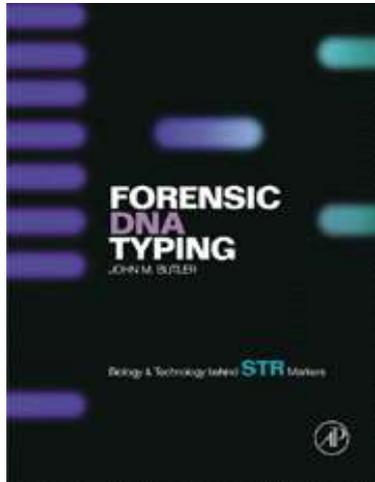


Forensic DNA Typing Textbooks Have Set the Standard for the Field

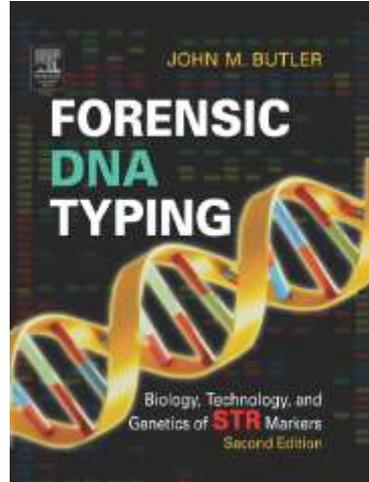
1st Edition

2nd Edition

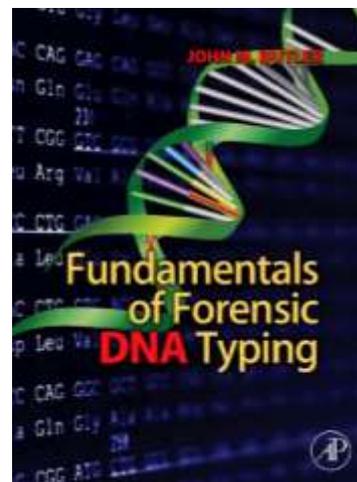
3rd Edition (3 volumes)



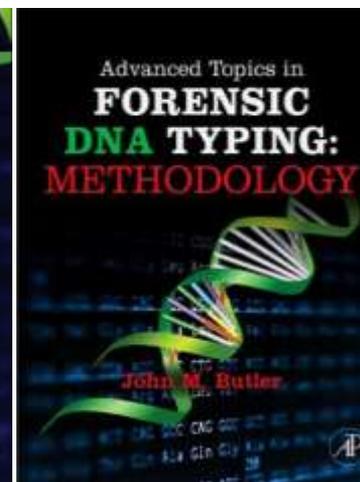
Jan 2001
335 pages



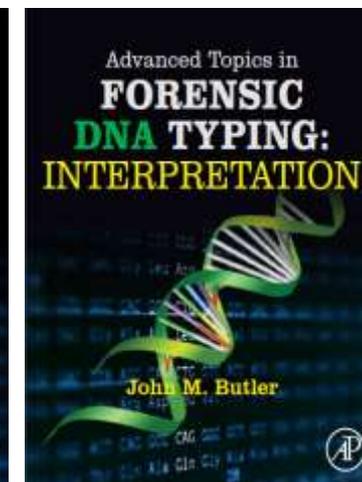
Feb 2005
688 pages



Sept 2009
520 pages



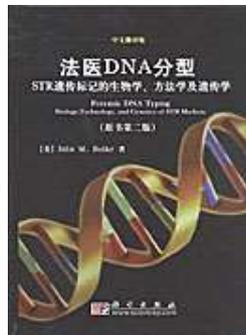
Aug 2011
704 pages



Oct 2014
604 pages

Language Editions

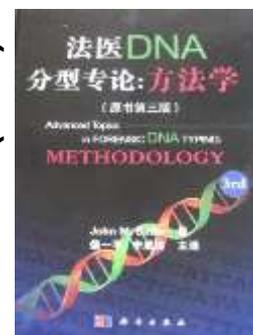
Chinese (2007)



Japanese (2009)



Chinese (2013)



Background Information on NIST

- Started in 1901 with roots back to the Constitution
- Name changed to **National Institute of Standards and Technology (NIST)** from National Bureau of Standards in 1988
- Primary campus in Gaithersburg, Maryland (just outside of Washington, D.C.)
- Part of the U.S. Department of Commerce
- >3,000 employees and >2,000 associates
- Supply >1300 reference materials
- Defines official time for the U.S.



Types of Standards

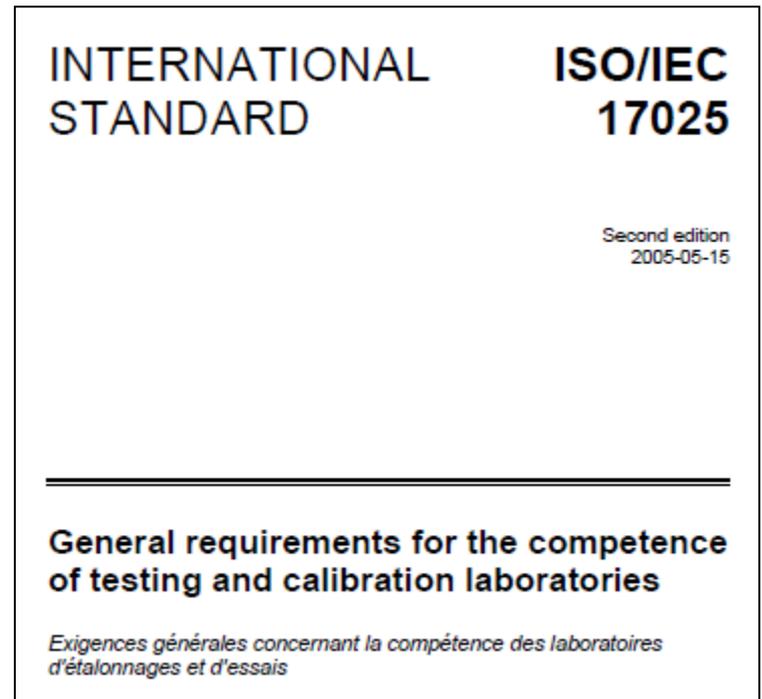
physical (measurement) standards



Certified reference material to aid with calibration of measurements

<http://www.nist.gov/srm/>

documentary (technical) standards



Specific requirements for the operation of a laboratory related to management system and competence

U.S. Innovation Agenda – NIST has an increasing role



Examples of NIST Programs Addressing National Priorities:

- Advanced Communications
- Advanced Manufacturing
- Climate Assessment
- Cybersecurity
- Energy
- **Forensic Science**
- Healthcare
- Nanotechnology

NIST's Early History in Forensic Science Research

- **1913** - Wilmer Souder was asked to calibrate some precision measuring devices sent to him by famed handwriting expert Albert Osborn.
- By the 1930s – Souder was recognized as a pioneer researcher in questioned documents, handwriting, typewriting, ballistics, and firearms.
- Souder was instrumental in setting up the FBI Laboratory, which opened in 1932

NIST began work with fingerprints in the 1960s and with DNA in the 1990s



DR. WILMER SOUDER
Washington, D. C.

Dr. Wilmer Souder: Early Handwriting Expert



Wilmer Souder in his NBS laboratory around 1925

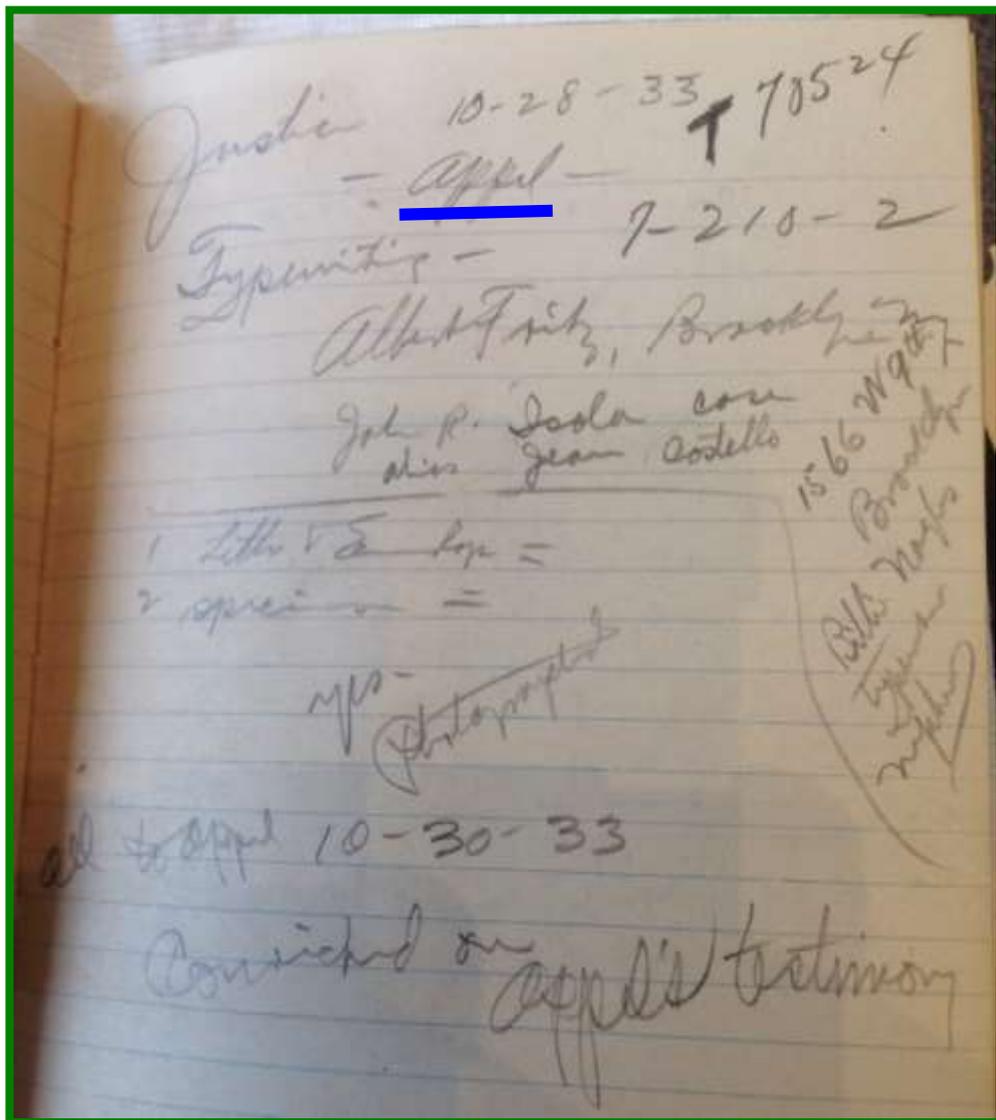


Souder's notebooks documenting his involvement in handwriting cases between 1929 and 1953

- **National Bureau of Standards*** (1911-1913, 1917-1954)
 - His PhD research at the University of Chicago 1913-1916 on the photoelectric effect led to Robert Millikan receiving the 1923 Nobel Prize in Physics
- Chief of the NBS Identification Laboratory (est. ~1921) and Dental Research Laboratory (est. 1919)
- **Based on notebook records recently rediscovered, he served as a Federal expert in hundreds of handwriting, typewriter and ballistic identification cases during the 1920s through the 1950s**
- **Helped set up the FBI Laboratory in 1932** and provided training to the FBI and other forensic labs in document examination and ballistics
- Testified for the prosecution in the Bruno Hauptmann (Charles Lindberg baby kidnapping) trial in 1935
- Active member of IAI and IACP and many other scientific organizations

*NBS changed its name to NIST in 1988

A page from one of Wilmer Souder's notebooks (rediscovered June 2015)



Typewriting casework received from the Department of **Justice** – Charles **Appel** (first FBI Laboratory employee) on October 28, 1933 (10-28-33)

All [material returned] to **Appel** on October 30, 1933 (10-30-33)

Convicted on Appel's testimony

HANDWRITING TESTIMONY IS ENDED

DULL EVIDENCE HAS TIRED JURY; STATE CHANGES STRATEGY

Parade Of Experts Links Hauptmann With The Notes

FLEMINGTON, N. J., Jan. 16.—Albert D. Osborn, son of a previous witness, today was the seventh government expert to charge the writing of the Lindbergh notes against Bruno Richard Hauptmann, accused as the murderer of Charles A. Lindbergh, Jr.

Osborn, 40, added the weight of his handwriting knowledge in declaring at the start of his testimony that the hand that wrote the ransom notes also wrote Hauptmann's application for an automobile license and the "request" writing done after his arrest.

Harry E. Cassidy, government handwriting expert from Richmond, Va., identified writing in the Lindbergh ransom notes as that of Hauptmann.

Cassidy became the fifth expert to link the man accused of the murder to the writing of the letters which led to Col. Lindbergh's payment of \$50,000 for the return of the child he never saw alive again.

Wilmer Souder, of the U. S. Bureau of Standards, considered one of the government's greatest investigators of handwriting and documents, followed Cassidy and delivered a scholarly pronouncement regarding his opinion that Hauptmann tried to disguise his handwriting when he composed the ransom demands.

The defense moved today to strike out the testimony of Morton Maish, Wyoming, O., thumb guard manufacturer, who swore yesterday that metal thumb guards would not corrode when exposed to the air. The motion was denied.

The state has more handwriting experts ready to testify that Hauptmann's heavy hand penned the crudely disguised writing in the ransom notes.

It decided to withhold them because it felt the jury was tired of scientific testimony and wanted sensations. Justice Thomas W. Trenchard, tired of repetitions and long cross-examinations, asked that the trial be speeded up.

It has been a wearisome, but necessary performance. When the first Osborn talked to the jury, he obtained close attention for two reasons. First, because he was the first of the experts to declare the ransom letters were written by Hauptmann; second, because he gave an entertaining lecture on handwriting, and few in his large audience had ever heard anything like it.

The National Bureau of Standards' Identification Laboratory (1935) One of the Nation's First Forensic Laboratories

Dr. Wilmer Souder:
Photo taken April 11, 1935

Photo re-discovered
August 5, 2015 in the
National Archives





Wisdom of Wilmer Souder

National Bureau of Standards (1911-1913, 1917-1954)

“The honest expert never looks upon the outcome of his work as a result of luck, the reward of a game, or victory in a battle of wits. He has built his qualifications through hard work. He establishes his conclusions through exacting procedures; he presents his testimony in the face of keen opposition and asks no favor beyond an honest consideration of the facts disclosed. Having done so, he has fulfilled the high obligations of his profession.

“Justice is sometimes pictured as blindfolded. However, scientific evidence usually pierces the mask.”

- **Wilmer Souder**, “Effective Testimony for Scientific Witnesses”, *Science* (1954) 119: 819-822



Co-lead with DOJ

National Commission on Forensic Science

**NIST Point-of-Contact (POC):
John Butler**

A federal advisory committee for the U.S. Department of Justice

<http://www.justice.gov/ncfs>



Organization of Scientific Area Committees

POC: Mark Stolorow & John Paul Jones

NIST-administered effort dedicated to identifying and developing technically sound, consensus-based documentary standards and guidelines

<http://www.nist.gov/forensics/osac/>



NIST

Forensic Science

NIST Forensic Science Center of Excellence (announced May 2015)

Research Program

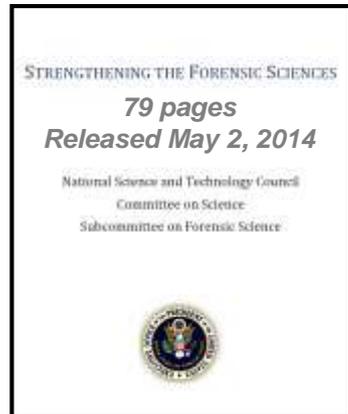
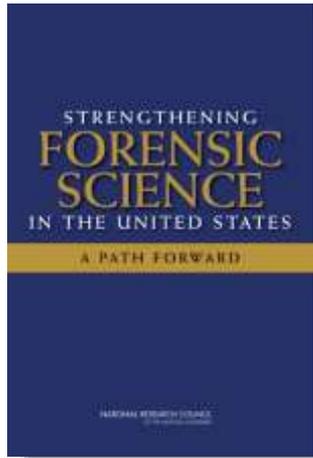
POC: Sue Ballou

SIX FOCUS AREAS

1. *Ballistics and Associated Tool Marks*
2. *Digital and Identification Forensics*
3. *Forensic Genetics*
4. *Toxins*
5. *Trace*
6. *Statistics*

<http://www.nist.gov/forensics>

NCFS and OSAC: U.S. Efforts to Strengthen Forensic Science



http://www.whitehouse.gov/sites/default/files/microsites/ostp/NSTC/strengthening_the_forensic_sciences_may_-_2014.pdf

- National Academy of Sciences (**NAS**) **report** issued in Feb 2009
- White House **Subcommittee on Forensic Science** (SoFS) operated from July 2009 to Dec 2012

DOJ/NIST Partnership (announced Feb 2013)

1. **NCFS** (National Commission on Forensic Science)
 - **First meeting held February 3-4, 2014 in Washington DC**
2. **OSAC** (Organization of Scientific Area Committees)
 - **542 members named; first public meetings held in Feb 2015**

National Commission on Forensic Science

A Federal Advisory Committee
for the U.S. Department of Justice



<http://www.justice.gov/ncfs>

National Commission on Forensic Science (NCFS)

www.justice.gov/ncfs

Policy-focused

NCFS Leadership

In 2013, the Department of Justice (DOJ) established the National Commission on Forensic Science, in partnership with the National Institute of Standards and Technology (NIST), to enhance the practice and improve the reliability of forensic science. This unique partnership draws upon each agency's core strengths to promote scientific validity, reduce fragmentation, and improve federal coordination of forensic science.

The Commission is co-chaired by Deputy Attorney General James M. Cole and NIST Acting Director and Acting Under Secretary of Commerce for Standards and Technology, Willie May. Nelson Santos, Deputy Assistant Administrator for the Office of Forensic Sciences at the Drug Enforcement Administration, and John M. Butler, Special Assistant to the NIST Director for forensic science, serve as vice-chairs. Brette Steele, Senior Advisor on Forensic Science and Senior Counsel to the Deputy Attorney General serves as the Designated Federal Officer and Robin Jones, Consultant within the Department of Justice, serves as Program Manager.

The Commission includes federal, state and local forensic science service providers; research scientists and academics; law enforcement officials; prosecutors, defense attorneys and judges; and other stakeholders from across the country.

GENERAL INFORMATION
NATIONAL COMMISSION ON FORENSIC SCIENCE

CONTACT

Brette Steele
Brette.L.Steele@usdoj.gov

By Phone:
(202) 305-0180

STAY CONNECTED



Sally Q. Yates
Deputy Attorney General
DOJ Co-Chair



Willie E. May
Director of NIST
NIST Co-Chair



Nelson A. Santos
Vice-Chair (DOJ)



John M. Butler
Vice-Chair (NIST)

32 voting and 8 ex-officio members

Next meeting (8th): December 7-8, 2015

Vice-Chairs of the National Commission on Forensic Science: John Butler (NIST) and Nelson Santos (DOJ)



Photo taken before our
AAFS 2015 talk regarding
the National Commission
on Forensic Science

February 3-4, 2014 was the first meeting of the **National Commission on Forensic Science**



*First meeting was
not webcast but
future ones will be*

37 Commissioners + DOJ/NIST Leadership Team (with ~100 public attendees)

Timeline for Commission Activities

**Federal Advisory
Committees exist
on a 2-year
renewal cycle**

**New Commission
charter signed on
April 23, 2015**

**Includes digital
evidence**

- Commission membership named (January 10, 2014)
- *First* Commission meeting (February 3-4, 2014)
- *Second* Commission meeting (May 12-13, 2014)
- *Third* Commission meeting (August 26-27, 2014)
- *Fourth* Commission meeting (October 28-29, 2014)
- *Fifth* Commission meeting (January 29-30, 2015)

- *Sixth* Commission meeting (April 30-May 1, 2015)
- *Seventh* Commission meeting (August 10-11, 2015)
- *Eighth* Commission meeting (December 7-8, 2015)



Organization of Scientific Area Committees (OSAC)

- **A NIST-administered effort** begun in 2014 in collaboration with the U.S. Department of Justice
- Involves >500 subject matter experts in more than 20 different forensic disciplines
- OSAC goals are to identify and develop technically sound, consensus-based documentary standards and guidelines **to improve the practice of forensic science**

<http://www.nist.gov/forensics/osac/index.cfm>

Listing of Scientific Working Groups (SWGs) as of 2013

	Scientific Working Group (SWG)	Topic (Forensic Discipline)	Start	Sponsor	Website
1	SWG DAM	DNA	1988	FBI	swgdam.org
2	SWG MAT	Materials (Trace)	1992	FBI	swgmat.org
3	SWG FAST	Friction Ridge (Fingerprints)	1995	FBI	swgfast.org
4	SWG DRUG	Controlled Substances	1997	DEA	swgdrug.org
5	SWG IT	Imaging Technologies	1997	FBI OTD	swgit.org
6	SWG DOC	Document Examination	1997	FBI	swgdoc.org
7	SWG DE	Digital Evidence	1998	FBI OTD	swgde.org
8	SWG GUN	Firearms & Toolmarks	1998	FBI	swggun.org
9	SWG FEX	Fire Debris & Explosives	1998	NIJ	swgfex.org
10	SWG STAIN	Bloodstain Pattern	2002	NIJ	swgstain.org
11	SWG TREAD	Shoeprint & Tire Tread	2004	FBI	swgtread.org
12	SWG DOG	Dog & Orthogonal Detector	2004	FBI	swgdog.fiu.edu
13	SWG GSR	Gun Shot Residue	2007	NIJ	swggsr.org
14	SWG ANTH	Anthropology	2008	FBI	swganth.org
15	SWG TOX	Toxicology	2009	NIJ	swgtox.org
16	FISWG	Facial Identification	2009	FBI OTD	fiswg.org
17	SWG DVI	Disaster Victim Identification	2010	FBI	swgdvi.org
18	SWG MDI	Medicolegal Death Investigation	2010	NIJ/FBI	swgmdi.org
19	SWG GEO	Geological Materials	2011	USACIL	swggeo.org
20	SWG WILD	Wildlife Forensics	2011	USFWS	wildlifeforensicscience.org/swgwild
21	SWG SPEAKER	Voice Analysis	2012	FBI	swg-speaker.org

Organization of Scientific Area Committees (OSAC)

Forensic Science Standards Board (FSSB)

Legal Resource
Committee (LRC)

Quality Infrastructure
Committee (QIC)

Human Factors
Committee (HFC)

Biology/DNA
SAC

Chemistry/
Instrumental Analysis
SAC

Crime Scene/
Death Investigation
SAC

Digital/Multimedia
SAC

Physics/Pattern
Interpretation
SAC

Biological Data
Interpretation and
Reporting Sub

Fire Debris and Explosives Sub

Anthropology Sub

Digital Evidence Sub

Bloodstain Pattern
Analysis Sub

Biological Methods Sub

Geological Materials Sub

Disaster Victim
Identification Sub

Facial Identification Sub

Firearms and
Toolmarks Sub

Wildlife Forensics Sub

Gunshot Residue Sub

Dogs and Sensors Sub

Speaker Recognition Sub

Footwear and Tire Sub

Materials (Trace) Sub

Fire and Explosion
Investigation Sub

Video/Imaging Technology
and Analysis Sub

Forensic Document
Examination Sub

Seized Drugs Sub

Medicolegal Death
Investigation Sub

Friction Ridge Sub

Toxicology Sub

Odontology Sub

SAC = Scientific Area Committee
Sub = Subcommittee

Currently 131 affiliates (from >1300 applicants) are assisting with task

NIST Forensic Science Research



NIST Forensic Science Research Efforts

Assisting the forensic science community through:

- Scientific and technical advances
- New analytical tools and supporting infrastructure
- Scientific validation of currently applied instrumentation and methods
- Evaluation of models, methods, and standards
- Performance and validation studies to define and estimate error rates

Forensic Science Research Program

Goal:

To advance the use of scientifically valid methods and techniques to improve the understanding of uncertainty and error in forensic evidence analysis

Forensic Science Research Program

Objectives:

1. Provide tools, reference materials, and techniques to support existing validated methods and technologies
2. Initiate new projects to strengthen existing measurement methods and technologies
3. Obtain feedback from community through outreach and education on potential needs/gaps/projects

Common Themes

- Error and Uncertainty
- Data and Information
- Algorithm Development
- Method Validation
- Training

Forensic Genetics

5 Year Goal: Assess new technologies and genetic markers for forensic applications and support the deconvolution and interpretation of complex DNA mixtures through software exploration and inter-laboratory studies.

Impact: Developers of STR typing kits have made changes on beta versions of their next-generation STR typing kits due to NIST research and have released new DNA typing technologies incorporating NIST's reference materials. Crime laboratories have used NIST's data in the creation of their DNA protocols.

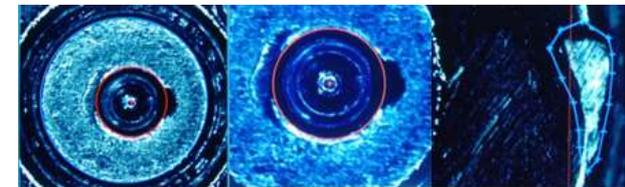
Reference Materials



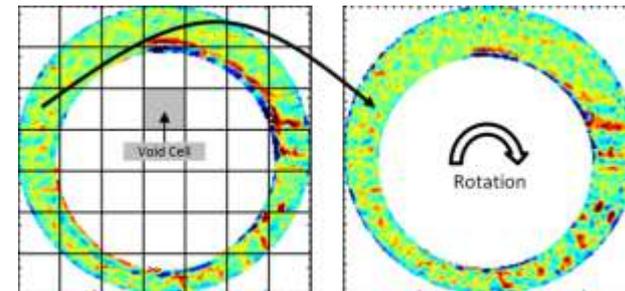
Ballistics and Toolmarks

5 Year Goal: To produce scientifically valid and objective measurement methods with error rate reporting that ultimately support a conclusion of identification for ballistic evidence, including laying the groundwork for use in court proceedings.

Impact: Research results have been adopted by crime labs and industry such as the FBI and Sensofar. State and federal crime labs are working to implement and validate recent advances in error rate reporting. The NIST standard bullets and cartridge cases have sold widely and are used throughout the world for quality control and training.



Credit: Theodore Vorbuger/NIST



Digital and Identification Forensics

5 Year Goal: Provide standards and measurement to improve the quality, efficiency and understanding of digitally-based forensics focusing on digital evidence tools, latent prints and biometric databases.

Impact: Vendors incorporate the NIST National Software Reference Library into their products and digital evidence (DE) laboratories use it to improve effectiveness and efficiency of DE processing. The Computer Forensic Tool Testing program improves tool performance and usage. The U.S. Supreme Court cited the NIST Guidelines on Mobile Device Forensics.



Statistical Methods

5 Year Goal: To make identifiable contributions to statistical methods for forensic science applications in the following areas:

1. study of statistical frameworks for evaluating evidence
2. development or deployment of improved statistical models and methods for different applications
3. development and use of appropriate uncertainty assessments for forensic test results
4. use of reproducible research approaches in forensic science research.

Impact: Working towards effective incorporation of statistical methods in forensic science through:

- training sessions,
- demonstrating the incorporation of approved methods in software, standards or guidelines for the forensic analyst and
- outreach to the community through publications and presentations

Drugs and Toxins

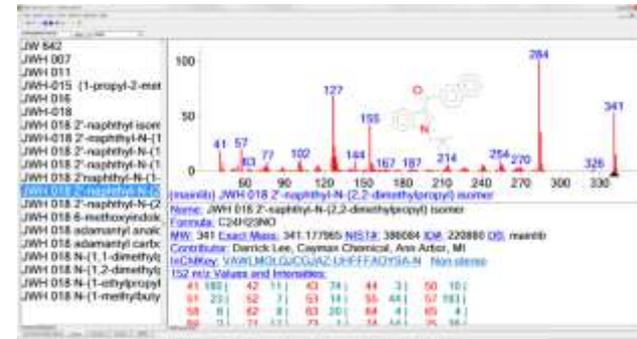
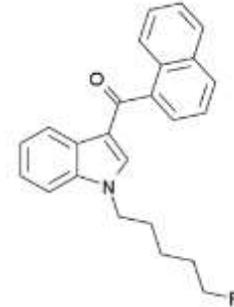
5 Year Goal: To establish a validated metrology infrastructure for confident drug identification and quantification. To produce scientifically valid and objective measurement methods with well defined uncertainties.

Impact: Development of:

- rapid identification approaches for new designer drugs;
- mass spectral database and reliable methods to allow identification and uncertainty evaluation for drugs of abuse.
- a marijuana breathalyzer test system to determine level of intoxication instead of



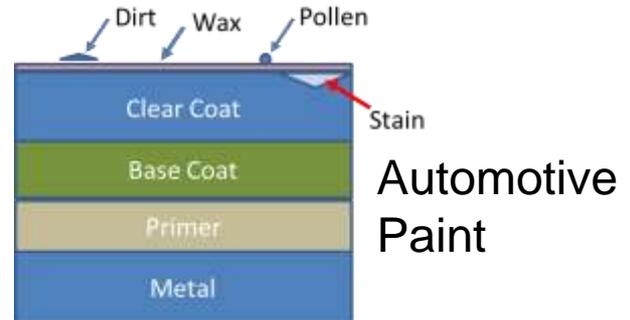
AM-2201, a synthetic cannabinoid



SensAbues™ filter holder

Trace Evidence

- **5 Year Goal:** To produce scientifically valid and objective measurement methods and uncertainties to support a conclusion on the comparison and origin of trace evidence.
- **Impact:** Move from subjective observation based conclusions to measurement based conclusions with calculable uncertainties.
- Develop methods, reference materials and databases that allow crime labs to rigorously and reproducibly measure and accurately interpret polymers (e.g. paints & fibers), particles & surfaces (e.g. gunshot residue & ambient particle populations), and arson vapor evidence.



NIST Forensic Science Center of Excellence (FSCOE)

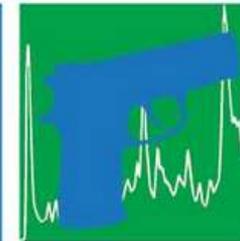
- NIST has committed to invest \$20M over 5 years in the FSCOE
- Goals: (1) **improve the statistical foundation for pattern evidence** (fingerprints, firearms, tool marks, etc.) **and digital evidence** (computer, video, and audio analyses) and (2) **develop education and training on probabilistic methods** for practitioners and other relevant stakeholders
- Awardees: A consortium effort led by Iowa State involving Carnegie Mellon, University of California-Irvine, and the University of Virginia



FORENSIC SCIENCE
ERROR MANAGEMENT

INTERNATIONAL
FORENSICS SYMPOSIUM

JULY 20-24, 2015 • WASHINGTON, DC



- **432 participated** from **>35 states** and **11 countries**
- 2 keynote speakers (Brandon Mayfield & Steven Wax)
- 8 world-renowned plenary speakers
- 42 sessions across 8 technical tracks
 - **105 individual platform presentations**
 - **9 panels**
- Symposium concluded with a **moot court presentation**

<http://www.nist.gov/director/orals.cfm>

Science Magazine reported on the NIST-organized Forensic Science Error Management meeting



SCIENCE AND THE LAW

Forensic labs explore blind testing to prevent errors

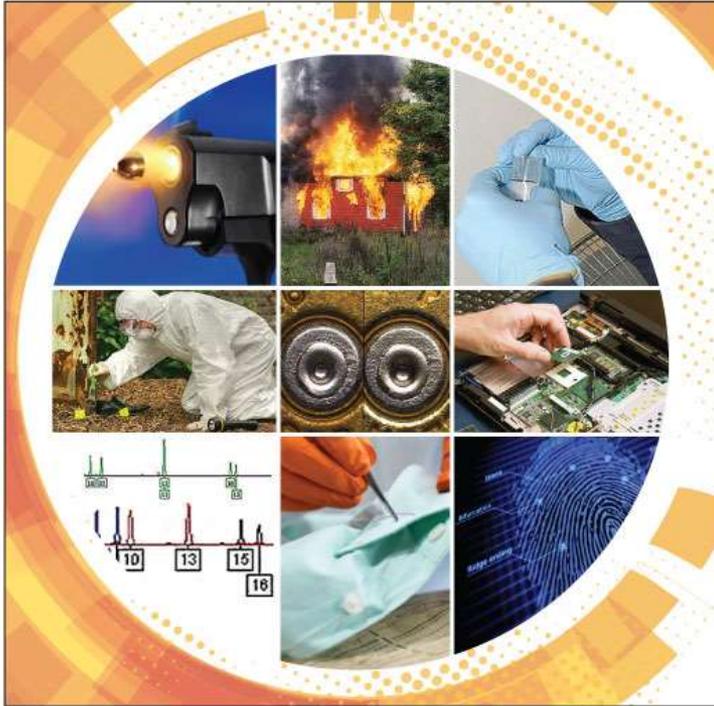
Evidence examiners get practical about fighting cognitive bias

By Kelly Servick

Shaken by revelations of unreliable results in crime labs, some forensic scientists are urging their colleagues to adopt a basic research practice: the blind experiment. Last week, at the first International Symposium on Forensic Science Error Management in Arlington, Virginia, nearly 500 scientists, lab managers, and other practitioners confronted the factors that lead them to make mistakes. A key problem, many said, is that people who evaluate evidence from crime scenes have access to information about a case that could bias their analysis.

science. His presence at the meeting, organized by the National Institute of Standards and Technology (NIST), was one sign of the field's eagerness for reform after a decade of humbling revelations. A 2009 report from the National Research Council concluded that many forensic disciplines lacked a firm foundation in science and produced inconsistent, unreliable results. In response, NIST and the Department of Justice assembled both a national commission on forensic science to suggest policies that will strengthen the field and 24 discipline-specific expert committees to make practical recommendations to more than 400 U.S. labs.

Biannual Conference to Showcase NIST Research



FORENSICS @ NIST

November 28-30, 2012 at NIST

- **52 presentations** covering DNA, firearms and toolmarks, fire research, trace sampling, drug analysis, computer and multimedia forensics, fingerprints, facial and speaker recognition
- Presentations and video are available for downloading and viewing

December 3-4, 2014 at NIST

- 20 presentations & 30 posters

Forensics@NIST 2016

Nov. 8-9, 2016

<http://www.nist.gov/oles/forensics-2012.cfm>

<http://www.nist.gov/forensics/forensics-at-nist-2014.cfm>



U.S. initiatives to strengthen forensic science & international standards in forensic DNA

John M. Butler*

National Institute of Standards and Technology, Gaithersburg, MD, USA

- This review article covers recent U.S. activities to strengthen forensic science including the formation of the National Commission on Forensic Science and the Organization of Scientific Area Committees
- DNA documentary standards and guidelines from organizations around the world are also included

FSI Genetics Special Issue (Vol. 18, September 2015)

Author(s)	Article Title (Invited Review Articles)
John Butler	U.S. initiatives to strengthen forensic science & international standards in forensic DNA
Titia Sijen	Molecular approaches for forensic cell type identification : on mRNA, miRNA, DNA methylation, and microbial markers
Manfred Kayser	Forensic DNA phenotyping : predicting human appearance from crime scene material for investigative purposes
Chris Phillips	Forensic genetic analysis of bio-geographical ancestry
Robin Cotton & Matthew Fisher	Properties of sperm and seminal fluid , informed by research on reproduction and contraception
Claus Børsting & Niels Morling	<u>Next generation sequencing</u> and its applications in forensic genetics
Erica Romsos & Peter Vallone	Rapid PCR of STR markers : applications to human identification
Peter Gill et al.	Genotyping and interpretation of STR-DNA : low-template, mixtures and database matches – 20 years of research and development
K. Gettings et al.	<u>STR allele sequence variation</u> : current knowledge and future issues
Just, Irwin, Parson	Mitochondrial DNA heteroplasmy in the emerging field of <u>massively parallel sequencing</u>
Toni Diegoli	Forensic typing of short tandem repeat markers on the X and Y chromosomes
Ogden & Linacre	Wildlife forensic science : a review of genetic geographic origin assignment
Maria Brión et al.	<u>Massive parallel sequencing</u> applied to the molecular autopsy in sudden cardiac death in the young

NIST Forensic Science Efforts

National Commission on Forensic Science (NCFS)



*Department of Justice FACA
co-led by NIST
setting policy*

Organization of Scientific Area Committees (OSAC)



*NIST-administered
>540 members of the community
establishing standards and best practices*

NIST Funded Internal Research Programs



*~\$7.5M/year
invested*

NIST Forensic Science Center of Excellence



*CoE: ~\$4M/year invested
for 5 years (2015-2020)*

International Symposium on Forensic Science Error Management



432 participants (11 countries)

Some Advice to Students...

Value of Personal Preparation

- Importance of self-education (continuing education) – READ, READ, READ! ... I have never had a single class on molecular biology (or statistics)!
- Importance of skills in oral and written communication (I took a class in public speaking while an undergraduate at BYU)

*Dans les champs de l'observation le hasard ne favorise
que les esprits préparés*

(Inaugural lecture, University of Lille, December 7, 1854)

Louis Pasteur
(1822-1895)



In the fields of observation **chance favors
only the prepared mind.**

The Importance of Hard Work

Thomas Alva Edison (1847-1931):

“There is no substitute for hard work.”

I am grateful to my parents for teaching me the value of hard work and the importance of self-education.

President Calvin Coolidge

- **Nothing in the world can take the place of persistence.** Talent will not; nothing is more common than unsuccessful men with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent. The slogan “Press on” has solved and always will solve the problems of the human race.

Mark Twain (1835-1910)

- Always do right. This will gratify some people, and astonish the rest...

Alexander Hamilton

- Men give me some credit for genius, but all of the genius I have lies in this. **When I have a subject in mind, I study it profoundly**, day and night it is before me. I explore it in all its bearings. My mind becomes pervaded with it. The result is what some people call the fruits of genius, whereas **it is in reality the fruits of study and labor** (as quoted in Sterling W. Sill, *The Upward Reach*, p. 125).



Greg Matheson on Forensic Science Philosophy

The CAC News – 2nd Quarter 2012 – p. 6

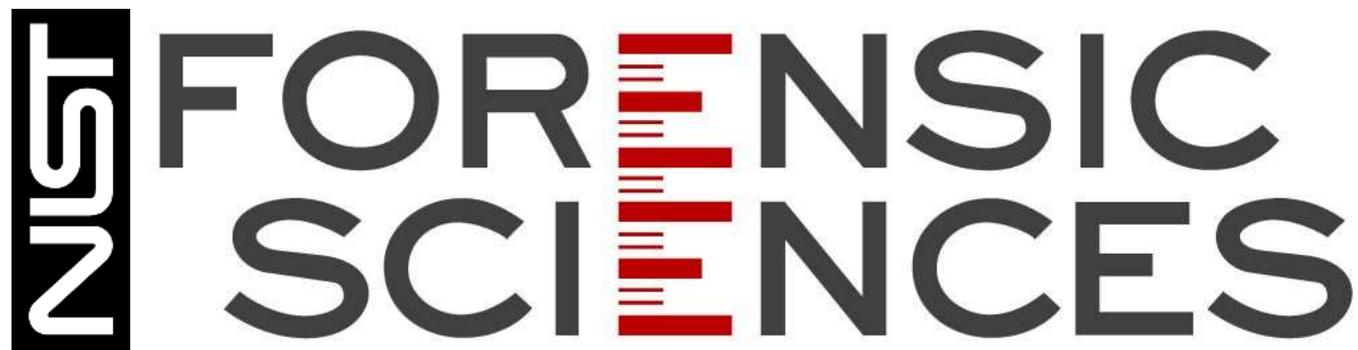
“Generalist vs. Specialist: a Philosophical Approach”

<http://www.cacnews.org/news/2ndq12.pdf>

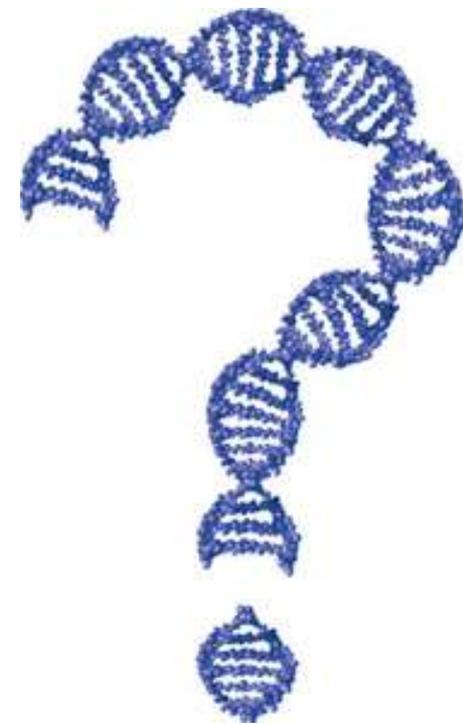
- If you want to be a technician, performing tests on requests, then just focus on the policies and procedures of your laboratory. If you want to be a scientist and a professional, learn the policies and procedures, but go much further and learn the philosophy of your profession. **Understand the importance of why things are done** the way they are done, the scientific method, the viewpoint of the critiques, the issues of bias and the importance of ethics.

National Commission on Forensic Science (NCFS):
www.justice.gov/ncfs

Organization of Scientific Area Committees (OSAC):
www.nist.gov/forensics/osac/index.cfm



www.nist.gov/forensics



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